THE DEMPSTER HIGHWAY - Benefits to the Arctic

by

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The Dempster Highway running through the north Yukon from Dawson to Inuvik will provide the first road connection between Canada South and the Arctic. This new frontier route will provide considerable economic and social benefits to the Western Arctic and will facilitate resource development in the Northern Yukon and Mackenzie Delta areas. The Dempster Highway starts at the Klondike Highway just south of Dawson and runs north westerly through the Ogilvie and Richardson Mountains to Fort McPherson, and Arctic Red River, where it connects with the Mackenzie Highway and carries on to Inuvik and the Arctic Ocean at Tuktoyaktuk. It is being constructed under the Federal Government's Northern Road Program and is scheduled for completion in 1974.

The Dempster Highway is named after the famed Northwest Mounted Police patrol which in the winter of 1911 under the leadership of Corporal W.J.D. Dempster traversed the route by dog team to discover the frozen bodies of the Fitzgerald patrol. The highway follows the overland trail between the Yukon and Peel Rivers and has been used for centuries by the Kutchin Indians. Following the Klondike gold rush at the turn of the century the Dawson Patrol operated by dog team from 1905 to 1917 between Dawson and Fort McPherson, a distance of 475 miles each way. The trip between Dawson and Fort McPherson took about one month by dog team. When the Dempster Highway opens this distance will be driven in one day.

As shown by the route map (Fig. 1), the Dempster Highway traverses the northern third of the Yukon Territory and the vast Mackenzie Delta region. It is the only highway in a 250,000 square mile area. The overall Northern Road Program is shown in Figure 2.

The opportunities and advantages offered to the residents of the Yukon and Northwest Territories by the Dempster Highway warrant considerable discussion, planning, and activity to optimize the benefits and minimize problems. The following information has been compiled to initiate a discussion on the utilization, operation, and social impact of the Dempster Highway.

Description

The Dempster Highway is designated as Yukon Highway No. 11 and starts at Mile 88 on the Stewart Crossing - Dawson Highway, 26 miles southeast of Dawson where the North Klondike River joins the main Klondike River at the gold mining town of Flat Creek. The mileages along the Dempster Highway are shown on the route map (Fig. 1) and the table of distances (Table 1). Much of the highway is still under construction and the actual mileages are not finalized.

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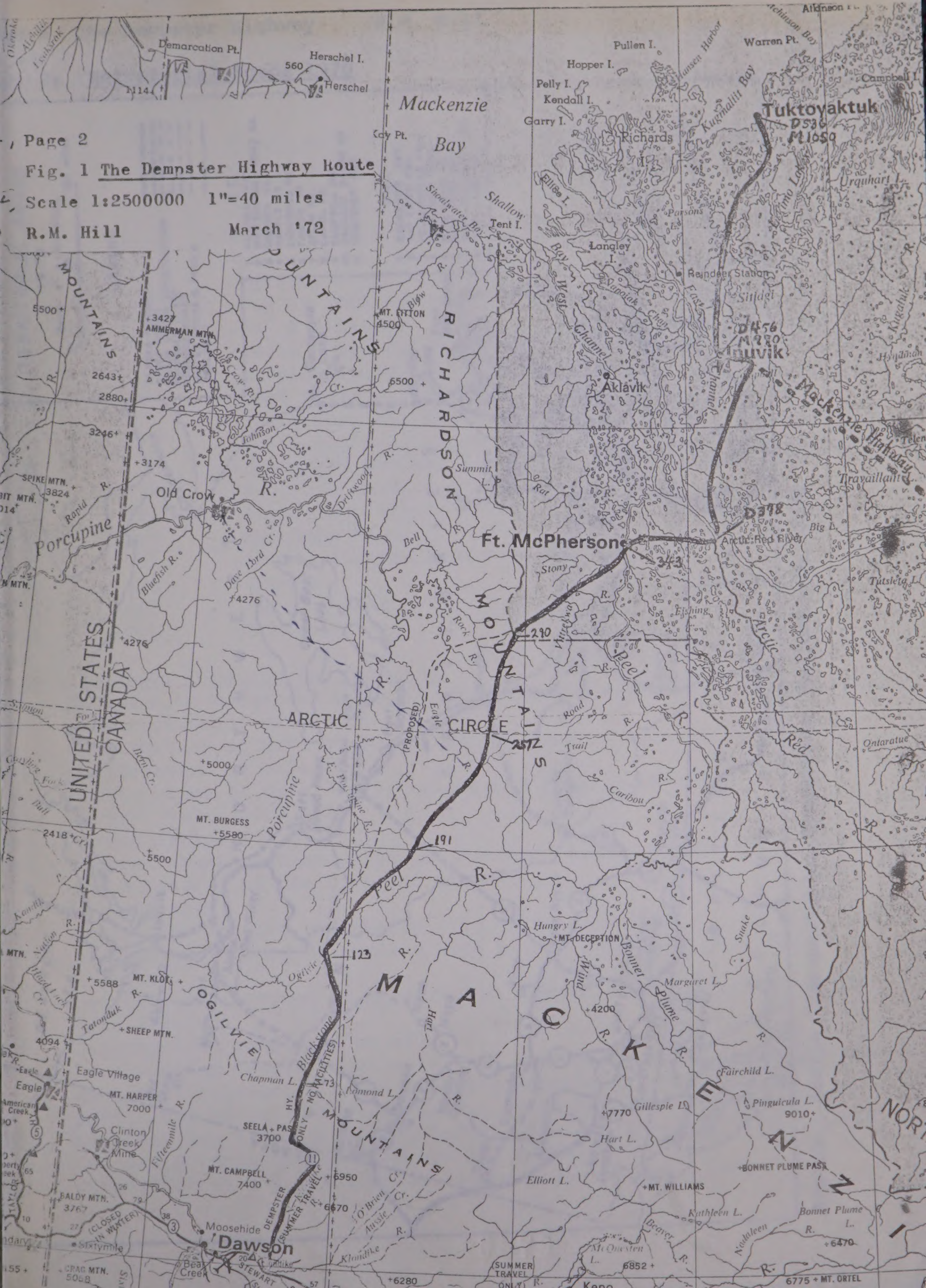
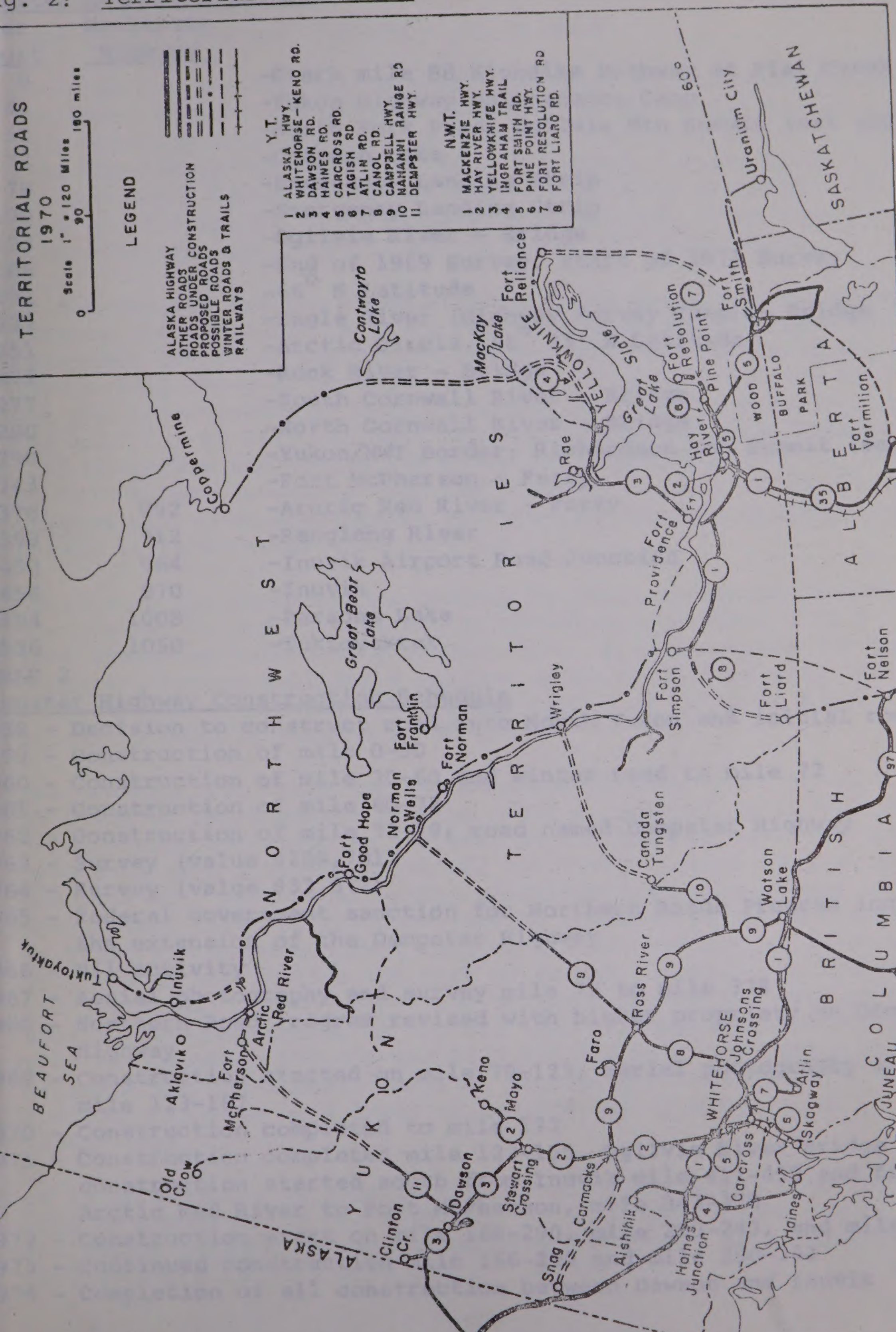


Fig. 1 The Dempster Highway Route

Scale 1:2500000 1"=40 miles

R.M. Hill March '72

g. 2: Territorial Roads 1970



Source: Arctic Transportation Conference, Yellowknife, 1970

LE 1

pster Highway Mileages

er ort	Mackenzie Highway	
0		-Start mile 88 Klondike Highway at Flat Creek
41		-Yukon Highway Maintenance Camp
50		-North Fork Pass: Ogilvie Mtn Summit (est 4300')
73		-Chapman Lake
78		-Emergency Landing Strip
100		-Emergency Landing Strip
123		-Ogilvie River - Bridge
166		-End of 1969 Survey, start of 1971 Survey
191		-66° N Latitude
237		-Eagle River (Highway Survey Camp) - Bridge
251		-Arctic Circle, 66° 33' N Latitude
272		-Rock River - Bridge
277		-South Cornwall River - Bridge
280		-North Cornwall River - Bridge
290		-Yukon/NWT Border: Richardson Mtn Summit (est 3300')
343		-Fort McPherson - Ferry
378	892	-Arctic Red River - Ferry
398	912	-Rengleng River
450	964	-Inuvik Airport Road Junction
456	970	-Inuvik
494	1008	-Parsons Lake
536	1050	-Tuktoyaktuk

BLE 2

empster Highway Construction Schedule

958 - Decision to construct road into North Yukon and initial route survey
959 - Construction of mile 0-30
960 - Construction of mile 30-60 and winter road to mile 72
961 - Construction of mile 60-72
962 - Construction of mile 72-79; road named Dempster Highway
963 - Survey (value $288,781)
964 - Survey (value $33,977)
965 - Federal government sanction for Northern Roads Program including the extension of the Dempster Highway
966 - Nil activity
967 - Aerial photography and survey mile 79 to mile 378
968 - Northern Road Program revised with higher propriety on Dempster Highway
969 - Construction started on mile 79-123; aerial photography and survey mile 123-167
970 - Construction completed to mile 123
971 - Construction completed mile 123-155, Ogilvie River Bridge completed; construction started south from Inuvik mile 417-450 and from Arctic Red River to Fort McPherson, mile 343-378
972 - Construction start on mile 166-290, mile 290-243, and mile 378-417
973 - Continued construction mile 166-290 and mile 290-343
974 - Completion of all construction between Dawson and Inuvik

Planning for the Dempster Highway commenced in 1958 during the "Northern Vision" era when petroleum exploration and initial oil well drilling were being carried out in the North Yukon. Until 1962 the highway was known as the Flat Creek - Eagle Plain road and was often described as the road "from igloo to igloo". From 1959 to 1962 the first 79 miles were completed. Then there was a considerable period of inactivity with no construction.

In the revised Northern Road Program presented in 1965 the Dempster Highway was scheduled to reach Fort McPherson by 1975 with the extension to Arctic Red River, Inuvik, and Tuktoyaktuk during the 1976 - 1985 ten-year program (5). In 1969 a contract was awarded for the construction of Mile 79 to 123 and surveys were initiated for Mile 123 to 167. In 1971 construction was started between Fort McPherson and Arctic Red River and south from Inuvik. Late in 1971 it was announced that the Dempster Highway construction program was to be accelerated and that the highway would reach Inuvik in 1974 rather than 1976 (9).

Details on the construction program by years are given in Table 2. The roadway is almost entirely an elevated embankment 2 to 5 feet above the surrounding ground (15). Specifications for the Dempster Highway call for a surface width of 28 feet with design considerations allowing for highway speeds of up to 50 m.p.h. and gross vehicle weights of 45 tons.

The construction costs for the Dempster Highway are difficult to estimate as the highway is being built in several sections with considerable variation in terrain, as the highway will not be completed with a finished surface for several years, and as some sections will have considerable maintenance expense before overall completion. Some of the construction contract values are given in Table 3. These contract figures are for basic road construction only and do not include the cost of survey, inspection, bridging and surfacing. From information on the Dempster Highway and other similar frontier roads, it appears that the construction costs will vary between $50,000 and $125,000 per mile and that a safe estimate for the overall Dempster Highway construction will be $100,000 per mile or a total of $53,600,000 from Dawson to Tuktoyaktuk.

It is interesting to compare these road cost figures with the cost of constructing the original 333 mile winter road during the summer of 1902 between Whitehorse and Dawson at a total cost of $129,000 or $390 a mile (17).

Nobody has said that the Dempster Highway should pay for itself, but it is interesting to speculate on the direct cost of the highway relative to the direct income from fuel taxes. On the assumptions that one mile of highway has an annual capital expense of $6,000 ($100,000 cost with 6% interest) and a maintenance expense of $2,700 totalling $8,700, that the fuel tax will be 15¢ per gallon, and that the average vehicle will travel 10 miles per gallon (trucks 5 miles per gallon and cars 20 miles per gallon) then 520,000 vehicles traffic per year will be required to carry the direct expense of the highway from fuel taxes. This amounts to 1.1 passes per minute in one direction or a vehicle every two minutes in both directions.

TABLE 3

Construction Contract Values for Dempster Highway

Mileage	Location	Cost	Distance	Cost Per Mile	Ref.
79-123	Chaplan Lake-Ogilvie R.	$ 1,796,000	44	$ 41,000	(8)
123-166	Ogilvie R. North	2,896,000	43	66,000	(10)
123-378	Ogilvie R.-Arctic Red	32,000,000*	255	125,000	(7)
343-378	McPherson-Arctic Red	4,438,700	35	126,000	(11)
378-417	North from Arctic Red	4,342,000*	39	111,000	est.
417-450	South from Inuvik	3,919,000	33	118,000	(11)

* estimate only

Utilization

Although the prime justification for the Dempster Highway is to serve the national purpose by opening up resource potential in the northern Yukon and Mackenzie Delta areas, there will be considerable utilization for regular freight, local traffic, and tourist travel to northern communities. It is impossible to predict with any degree of accuracy what utilization there will be of the Dempster Highway. However, with the aim of quantifying the road traffic in order to plan for the highway's operation and social impact, utilization estimates have been compiled in Table 4 under the headings of regular freight, local traffic, tourism, mineral exploration, mineral shipment, petroleum exploration, and pipeline construction. The anticipated traffic is shown for both optimistic and pessimistic conditions for the years 1975 and 1985. Total northbound estimates for the Dempster Highway in 1975 are 7000 vehicles optimistically and 2100 vehicles pessimistically.

The 1971 estimates for the Alaska Highway show a northbound traffic of 46,870 vehicles (14). In comparison the Dempster Highway traffic estimates as a percentage of Alaska Highway traffic are optimistically 15% in 1975 and 25% in 1985 and pessimistically under 5% for both 1975 and 1985. These relatively small percentages of the present Alaska Highway traffic appear realistic for the Dempster Highway because of the small population joined by the Dempster as compared to the large Alaska population (300,000 in 1970) and its association with the "lower 48". Air freight and the Mackenzie barge system also detract from utilization of the Dempster Highway.

The types of vehicles utilizing the Dempster Highway can be expected to be similar to those now using the Alaska Highway as shown in Table 5. This data from a summer survey shows 70% of the vehicles on the highway were for personal travel. Because of the different population situation the traffic on the Dempster Highway will probably have a much higher percentage of trucks.

The Pacific Great Eastern Railway has plans for a rail extension to Dease Lake in the Northeast Corner of British Columbia with possibilities for further extensions to Whitehorse and Faro. This rail link could even be extended into Alaska to service the Fairbanks-Anchorage regions as well as the petroleum developments on Alaska's north slope.

The completion of the Fort Nelson-Fort Simpson highway will also open another practical freight route to Inuvik via Fort Simpson by truck and barge from Edmonton or by rail, truck, and barge from Vancouver.

TABLE 4

Anticipated Traffic on Dempster Highway

	No. of northbound vehicles per year			
	1975		1985	
	Optimistic	Pessimistic	Optimistic	Pessimistic
Regular Freight	300	150	1000	300
Local Traffic	400	150	1000	300
Tourist Traffic	1000	450	2000	800
Mineral Exploration	150	150	500	200
Mineral Shipment	150	---	1000	---
Petroleum Exploration	1000	200	1500	200
Pipeline Construction	4000	1000	4000	500
Northbound vehicles per year	7000	2100	11000	2300
Northbound vehicles per day	19.2	5.7	30.1	6.3
Total annual traffic*	14000	4200	22000	4600
Total daily traffic	38.4	11.4	60.2	12.6

* Until the Mackenzie Highway is completed virtually every vehicle which moves north along the Dempster Highway will return south. Hence the total traffic in both directions for a location on the Dempster Highway can be expected to be double the above northbound figures.

TABLE 5

Types of Vehicles Utilizing Alaska Highway - Summer 1971

Northbound Traffic -	passenger cars	37%
	camper trucks	22
	cars with trailers	11
	2-axle trucks	14
	5-axle trucks	7
	buses	3
	other	6
	TOTAL	100%

Source: Ref. 14

A road extension from the Dempster Highway to Old Crow has not been included in any road program but is a possibility for consideration. Certainly the residents of Old Crow are interested and have often asked for this connection. From a map survey it appears that 130 miles of highway would be required and that it would generally follow the winter roads that have been utilized in the area during the last few years. Possibly the Old Crow connection would leave the Dempster Highway at the Eagle River (Mile 237) and head northeasterly over a relatively flat plateau directly to Old Crow. This route is shown as a dotted line on Figure 1.

a. - Regular Freight

The regular freight that will utilize the Dempster Highway will originate primarily in the south and will be delivered to the communities of Fort McPherson, Arctic Red River, Inuvik and Tuktoyaktuk. The communities of Old Crow, Aklavik, Sachs Harbour, and Paulatuk will also receive freight brought in over the Dempster Highway via highway extensions, winter roads, or air freighting. A small amount of return southbound freight can be anticipated.

The relative costs of transporting regular freight between the south and northern communities is shown using the example of traffic between Edmonton and Inuvik. The alternate routes, methods and distances are shown in Figure 3 and the relative costs of freighting are shown in Table 6. The costs are for bulk freight shipped in truckload or aircraft load lots. This means that a shipment of at least 20 tons would be required for a truckload and up to 125 tons for a Boeing 747F air freighter. Lesser quantities of freight will cost more per pound. Table 6 shows that the lowest cost for bringing freight from Edmonton to Inuvik is Alternate 3 at 3.80¢ a pound utilizing truck or rail to Hay River and barge down the Mackenzie to Inuvik. This system is only operational for 4 months a year from June to September. This truck-barge rate will probably amount to around 5.10¢ a pound for the average shipper. Prior to the opening of the Dempster Highway, freight for the northern communities will arrive by barge or air freight. Since the barge rates are considerably lower than highway trucking much of the freight will continue to travel on the river.

The next most economical transport method between Edmonton and Inuvik is by truck using the yet to be constructed Mackenzie Highway. At the very minimum cost of 5¢ per ton mile the expense would be 3.95¢ lb. The real rate would probably reflect the higher operating costs of frontier roads and be around 6.10¢ per pound as shown in Table 4. The Mackenzie Highway is scheduled

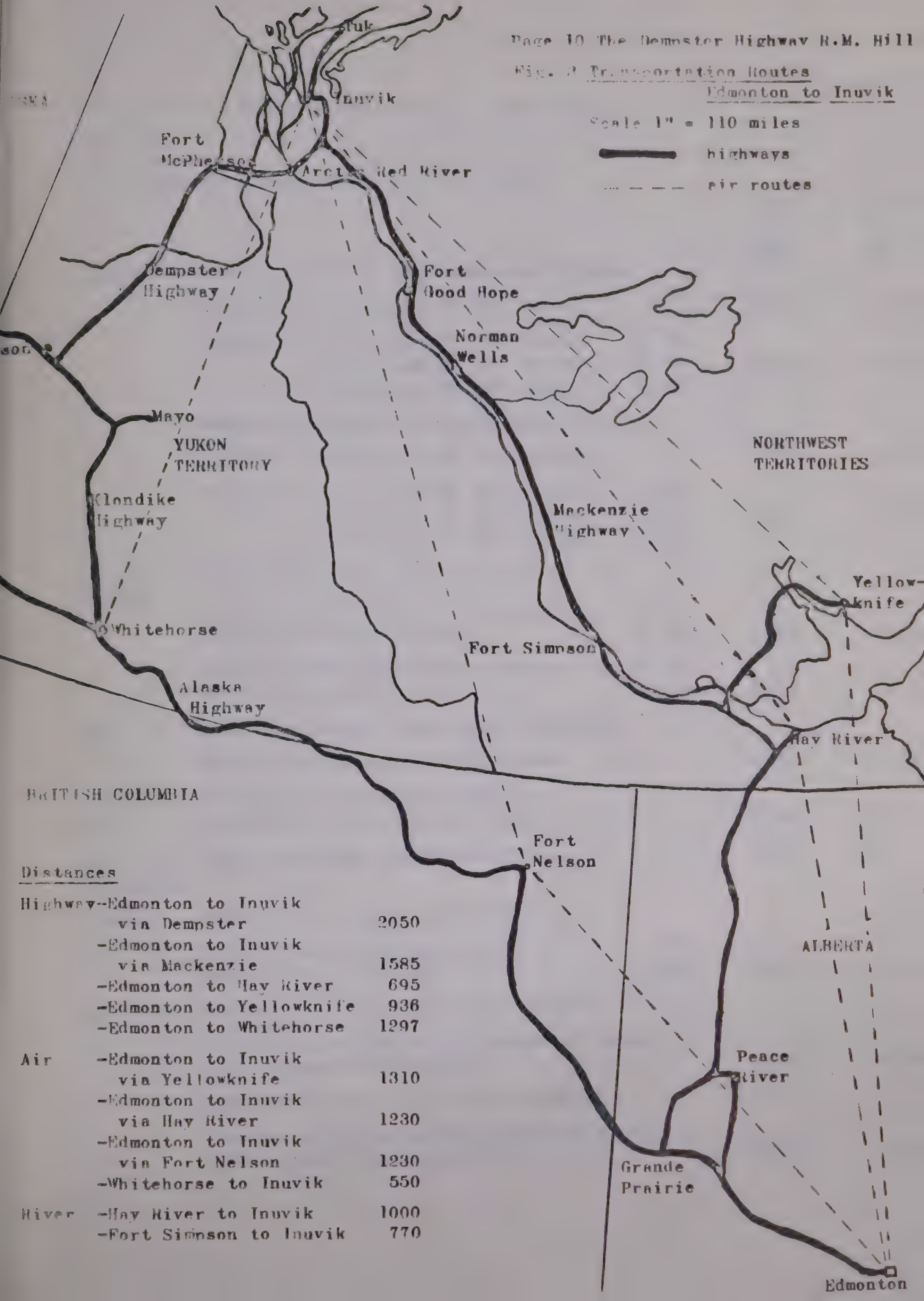


Fig. 2 Transportation Routes
Edmonton to Inuvik

Distances

Highway	-Edmonton to Inuvik via Dempster	2050
	-Edmonton to Inuvik via Mackenzie	1585
	-Edmonton to Hay River	695
	-Edmonton to Yellowknife	936
	-Edmonton to Whitehorse	1297
Air	-Edmonton to Inuvik via Yellowknife	1310
	-Edmonton to Inuvik via Hay River	1230
	-Edmonton to Inuvik via Fort Nelson	1230
	-Whitehorse to Inuvik	550
River	-Hay River to Inuvik	1000
	-Fort Simpson to Inuvik	770

TABLE 6

Bulk Freight Rates Edmonton to Inuvik

				Rate Per Ton	Rate Per Lb.
Truck	1.	Edmonton-Inuvik via Dempster Highway			
		Minimum 2050 miles @ 5¢ ton/mi		$102	5.12¢
		Probable 1297 miles @ 5¢ ton/mi	$ 65		
		333 miles @ 8¢ ton/mi	$ 27	$138	6.90¢
		458 miles @ 10¢ ton/mi	$ 46		
	2.	Edmonton-Inuvik via Mackenzie Highway			
		Minimum 1585 miles @ 5¢ ton/mi		$ 79	3.95¢
		Probable 781 miles @ 6¢ ton/mi	$ 45		
		173 miles @ 8¢ ton/mi	$ 14	$122	6.10¢
		631 miles @ 10¢ ton/mi	$ 63		
Truck	3.	Edmonton-Inuvik via Hay River			
Barge		Minimum 695 miles @ 5¢ ton/mi	$ 36		
		Mackenzie Barge System	$ 40	$ 76	3.80¢
		Probable 695 miles @ 6¢ ton/mi	$ 42		
		Mackenzie Barge System	$ 60	$102	5.10¢
Air	4.	Edmonton-Inuvik Hercules Transport			
		Charter $8,400 for 44,000 lbs.		$380	19.00¢
Truck	5.	Edmonton-Inuvik via truck to			
Air		Yellowknife and 737 to Inuvik		$340	17.00¢
Air Freight	6.	Containerized Edmonton-Inuvik		$540	27.00¢
Truck	7.	Edmonton-Inuvik via Whitehorse			
Air		1297 miles @ 5¢ ton/mi	$ 65		
		Whitehorse to Inuvik	$240	$305	15.25¢
Air	8.	Edmonton-Inuvik 707 Jet Freighter			
		16¢ ton mile including deadhead return			
		1230 miles @ 16¢ ton/mi		$197	9.85¢
	9.	Edmonton-Inuvik 747 Jet Freighter			
		12¢ ton mile including deadhead return			
		1230 miles @ 12¢ ton/mi		$147	7.35¢

for completion in the 1976 - 1985 Northern Road Program but the 650 mile section between Fort Simpson and Arctic Red River could be opened as early as 1976 if it was required for pipeline construction.

The Dempster Highway route between Edmonton and Inuvik via Dawson is 2050 miles and 465 longer than the Mackenzie Highway route. With the very minimum rate of 5¢ per ton mile the truck freighting cost would be 5.12¢ per pound. More realistically the rate will be higher at 6.90¢ per pound as shown in Alternate 1 of Table 4.

Combinations of truck-air and direct air shipments vary greatly in cost between 7.35¢ per pound and 27¢ per pound as shown in Table 4. Presently the most economical air transport into Inuvik is with a truck haul to Whitehorse and a direct flight to Inuvik at costs as low as 15.25¢ per pound.

Future air freight services with B 747 jet freighters carrying 125 ton loads operating at 7¢ per ton mile loaded and 5¢ per ton mile empty in the return flight would cost 7.35¢ per pound between Edmonton and Inuvik and would be close to competitive with truck transport on the Dempster Highway.

During 1967 a total of 14,200 tons of freight came into the Yukon over the Alaska Highway (13). For the 15,000 population this amounts to roughly 1 ton per capita. In the North Yukon and Mackenzie Delta areas there is a population of around 6,000 people with an inferred potential of 6,000 tons/year. This freight is equivalent to 300 truckloads of 20,000 lbs. each. As in the Yukon where most of the freight comes in via Skagway and the White Pass Railway (see Table 7), the major share of regular freight to the Mackenzie Delta area can probably be expected to use the more economical truck-barge system down the Mackenzie River rather than the Dempster Highway.

TABLE 7

Yukon Freight and Express Shipments - 1967

	Northbound	Southbound	Total
White Pass Route	66,000 tons	122,000 tons	188,000 tons
Highway Transport	14,200 tons	11,500 tons	25,700 tons
Airlines	327 tons	71 tons	398 tons
	80,525 tons	133,571 tons	214,098 tons

Source: The Yukon Economy. D. Wm. Carr & Assoc. July, 1968.

b. - Local Traffic

Although no permanent roads connect any of the communities served by the Dempster Route, there are many cars, trucks, and buses operating on the local roads. When roads on the river ice are opened, between Inuvik, Aklavik, and Tuktoyaktuk, numerous cars and trucks travel each week between the settlements.

There will be some personal travel by car from the northern communities to the South on the Dempster Highway, but as in the Yukon, most of the personal travel will continue to utilize the airlines for travel outside the region.

Local people in the northern communities will make considerable use of the Dempster Highway with trips for intercommunity travel, recreation, hunting, and trapping. This local traffic is estimated to be equivalent to 400 northbound vehicles each year in 1975 and to increase to 1000 vehicles each year by 1985.

c. - Tourism Traffic

The opening up of the Dempster Highway will allow travel into new exciting areas and considerable tourist traffic can be expected. The Dempster Highway opens up over 250,000 square miles of natural wilderness recreation, an area equivalent in size to the province of Alberta. When the Mackenzie Highway is completed tourists will be able to complete a circular tour through the North Yukon and return along the Mackenzie Valley.

In 1971 there were 180,000 tourists in the Yukon (13). Eighty percent of the tourists are from the U.S. and most of them are enroute to Alaska along the Alaska Highway.

Possibly 15 tourist cars a day will use the Dempster Highway during the initial years during the months of July and August giving a total of 1000 cars a year. This volume could be expected to double by 1980 and triple when the Mackenzie Highway connection opens.

With the completion of the Dempster Highway to Tuktoyaktuk and the Whitehorse-Skagway road, tourists will be able to drive from the Pacific Ocean to the Arctic Ocean. The State of Alaska has committed that the road between Skagway and the B.C. border will be completed by 1975. Hopefully the short section of the road through northern British Columbia will also be completed by this time.

A majority of the tourists driving the Dempster Highway to the Mackenzie Delta area can be expected to be from the U.S.A. A recent survey on the Alaska Highway showed that during the summer

months 2/3 of all the traffic is from the U.S.A. and that close to 80% of the tourists were Americans (14). This survey commented that "Canadians simply do not make a habit of travelling by road between the various centres along the highway because of the long distances involved" (14).

Tourist activities along the Dempster Highway will have little value to the region unless there is a development plan and involvement program for the northern residents. The tourist development plan would include evaluation, training and financing and the involvement program would structure the tourist operations for the advantage of the northern residents. In brief, tourism will not help the North unless the local residents are owner/managers rather than employee/workers.

Most of the tourist traffic can be expected in July and August. However the tourist development plan should work towards extending the season with fall hunting, "noon moon" tours in the winter, skiing in the Spring, and conferences to utilize accommodation during other slack periods, so that the capital investment will be optimized and employment will be throughout the year.

Tourist operations should be combined with other activities along the Dempster Highway such as the highway maintenance camps and service centers so that support services such as fuel, communications, water supply and sewage can be shared and be readily available at minimum cost to each user.

d. - Mineral Exploration

The geology of the region served by the Dempster Highway is mainly sedimentary with some intrusives. Known mineral resources are an iron formation occurring in a narrow belt extending 300 miles eastwards from Clinton Creek to the Snake River (12), gold in the Firth River area, copper along the Wind River, tungsten in the Blow River area, lead/zinc along the Procupine River and coal along the Beaufort coast. However at the present there are no producing mines.

The largest potential appears to be Crest Exploration's iron ore property along the Snake River, and the Pacific Giant iron ore property on the Wind River. Both of these properties are a considerable distance from the Dempster Highway and might better be served by a road running north from Elsa. The Hart River Mines 64 miles east of Dempster Highway Mile 52 has good potential for copper, lead, and zinc.

The 1968 Yukon Economy Report states that "mining dominates the Yukon economy in spite of the development of tourism" (12). Much of the mineral products are shipped out by a truck-rail combination using the 110 mile White Pass and Yukon Railway from Whitehorse to Skagway.

The Dempster Highway will be utilized both for mineral exploration and the shipping out of mineral products. The actual level of activity is dependent on transportation costs and the world mineral situation. However it is estimated that in 1975 there will be optimistically 150 truckloads for exploration and 150 truckloads for shipping out minerals. In 1985 it is estimated that this traffic could increase to 500 truckloads for mineral exploration and 1000 truckloads for shipping out minerals. These estimates along with pessimistic traffic estimates for mineral exploration and mineral shipment are shown in Table 4.

e. - Petroleum Exploration

Most of the region served by the Dempster Highway has potential for petroleum exploration and the production of oil and gas. Sixteen wells have been drilled in the Eagle Plain area (Mile 190 to 290) with five of them encountering hydrocarbons. Around 10 wells have been drilled in the Peel Plateau area with no hydrocarbon showings reported. Around 25 wells have been drilled in the Mackenzie Delta area with 6 of them showing oil or gas. The exploration success in North Alaska and in the Arctic Islands has stimulated considerable interests in the Dempster Highway region. The relative petroleum potentials for the North Yukon, mainland Northwest Territories and the Arctic Islands are shown in Table 8.

Should an oil or gas pipeline from the Alaskan North slope pass through the North Yukon or should mining properties require considerable energy, the petroleum potential along the Dempster Route will be developed.

Each geophysical operation requires around 50 tons of freighting and each drilling rig requires around 300 tons. Possible freighting to support petroleum exploration could amount to 20,000 tons year or 1,000 truckloads. It has been estimated that the petroleum industry will be shipping 275,000 tons of freight down the Mackenzie River in 1975 (19). Most of this freight will continue to come by the Mackenzie River because of the considerably lower rates but the traffic on the Dempster Route could readily double or triple if a significant oil field was developed.

TABLE 8

Northern Petroleum Potential

	Sedimentary Area	Volume of Sediments	Possible Petroleum Reserves
North Yukon	43,000 sq. mi.	64,500 cu. mi.	3.2×10^9 barrels
Mainland N.W.T.	205,000	267,100	13.3
Arctic Islands	350,000	663,500	33.2
TOTAL	598,000 sq. mi.	995,100 cu. mi.	49.7×10^9 barrels

f. - Pipeline Construction

There is considerable speculation that an oil pipeline and a gas pipeline will be constructed across the North Yukon and up the Mackenzie Valley for the transportation of petroleum products from North Alaska and the Mackenzie Delta areas. Construction of these pipelines is not likely to be underway until 1975 when the Dempster Highway can be utilized.

For the construction of a gas pipeline it has been estimated that 260,000 tons of freight would be required for the North Yukon and Lower Mackenzie Sections (18). On the assumption that 160,000 tons/year will be required for pipeline construction and that half of this requirement will be supplied by trucks carrying 20 ton loads, there will be 4,000 trucks a year traffic serving pipeline needs.

If one major pipeline is built to carry natural gas there will be a good possibility for the construction of a second line to carry crude oil. Also as there will be considerable local pipeline construction extending over several years for feeder lines, it is optimistically estimated that the pipeline construction traffic will continue at the same level of 4,000 truckloads a year through to 1985.

Operation

There are no official plans for the operation of the Dempster Highway. However, it can be expected that Yukon and Northwest Territorial Governments will be responsible for highway operation and that financing the cost of maintenance will be carried by the Federal Government for some time. This procedure is followed for most of the Northern Road Program projects and can be expected to continue for the Dempster Highway. Operation programs for the Dempster Highway include maintenance, communications, and associated developments.

a. - Maintenance

Experience along the Alaska Highway and other frontier roads indicates that highway maintenance camps should be located at least every 100 miles and preferably every 80 miles. Six highway construction camps have been suggested for the Dempster Highway between Dawson and Tuktoyaktuk. These camp locations were selected on the basis of being central in a maintenance section, suitability for a camp site with fresh water supply and waste disposal, and optimum social impact. The location and maintenance mileage for these Dempster Highway maintenance camps is shown in Table 9. A comparable listing for Alaska Highway maintenance camps is presented in Table 10.

Based on the experience of other comparable roads in the Yukon the annual maintenance expense for the Dempster Highway will amount to around $2,700 per mile or $1,230,000 for the 456 miles between Dawson and Inuvik (16). Dust control is extra and is estimated at $1,800 per mile per year or $821,000 total for 456 miles. In comparison the cost of maintaining the Alaska Highway in 1965 was $5,550 per mile plus $2,500 per mile for replacement of gravel and dust control (12).

The main maintenance problem will be dust control particularly in the summer with peak tourist utilization. Due to the relatively light expected traffic it will be very difficult to justify an expensive dust control program. The Northwest Territories section will be particularly expensive to maintain due to the shortage of gravel. The region traversed by the Dempster Highway is meteorogically a desert averaging only 10 to 15 inches of precipitation a year, half of which can be expected as snowfall. This snow can be expected to drift and require considerable plowing through the winter. Heavy rainstorms are uncommon but must be anticipated with provision for bridges and culverts to handle flash floods. Severe ice buildup can be expected in the bridges and culverts during the fall freezeup and spring thaw periods.

TABLE 9

Suggested Dempster Highway Maintenance Sections

No.	Section	Camp Location	Maintenance Mileages	Distance Between HMC
1	Klondike Pass	50	0 - 90	--
2	Ogilvie River	123	90 - 166	70
3	Eagle River	237	166 - 290	100
4	Ft. McPherson	343	290 - 378	110
5	Rengleng River	398	378 - 456	80
6	Parsons Lake	494	456 - 536	86

TABLE 10

Alaska Highway Maintenance Camps

Mile		Distance Between
101	Wonovan	---
163	Sikanni River	62
245	Prophet River	82
300	Fort Nelson	55
392	Summit Lake	92
456	Muncho Lake	64
543	Coal River	87
633	Watson Lake	90
733	Swift River	100
830	Brooks Creek	97
917	Whitehorse	87
1016	Haines Junction	99
1083	Destruction Bay	67
1202	Beaver Creek	119

Close to half of the Dempster Highway lies north of the Arctic Circle and will have periods of continuous darkness in the winter and continuous daylight in the summer. In the Mackenzie Delta area there will be around one mid-winter month without sunlight which will make both driving and road maintenance difficult.

b. - Communications

Much of the region served by the Dempster Highway is completely void of normal communication facilities. There are some radio messages going into transient exploration camps in the North Yukon and Old Crow, Fort McPherson and Arctic Red River are served by radio telephone from Inuvik.

For economic and safety considerations it is essential that effective communication be provided along the Dempster Highway. Due to the long distances and small populations it will probably not be economic for a telephone ground line along the route. Also experience with the C.N.T. line along the Mackenzie River, which has considerable problems during the winter, indicates that radio communications will be the most effective for the Dempster Highway. Possibly a public VHF radio telephone network can be established along the route so that every maintenance camp, service vehicle, and other operators can use the same service. Preferably a separate radio network would not be set up for maintenance crews so that they can contribute to the base cost of a communications system that will benefit all organizations along the highway.

Due to the remoteness of the route and the high danger factor from Arctic weather conditions there is need for traffic control and emergency services. During the winter months when danger is high and traffic light arrangements could be made for check points for all vehicles travelling the route, in the way that pilots file flight plans and canoeists travelling the Mackenzie River report in at each R.C.M.P. detachment. These check points could be located at the Ogilvie River, Eagle River, Fort McPherson and Inuvik.

c. - Associated Developments

Associated developments along the Dempster Highway include service stations, restaurants, motels, lodges and other service or recreation activities. Considerable care must be taken in planning positive highway developments with the full involvement of the local governments.

All of the land along side the Dempster Highway is now controlled by the Department of Indian Affairs and Northern Development in

the name of the Crown. Presently there is a land freeze along the highway to restrict speculative development. Prior to the present land freeze one operator set up business by the Ogilvie River bridge at Mile 123. Consideration could be given to allowing land use only through long term leases rather than outright sale. Highway maintenance camps, public service centers, government offices, and any other developments should be grouped together in mini-communities. Ribbon development along the Dempster Highway should be rigidly controlled to facilitate environmental protection and to minimize the high cost of providing social services such as education and medical care to individuals or small groups. Recreation sites should be developed along the highway at appropriate locations to serve the needs of local residents and tourists. These sites might be developed and operated by the Yukon Forest Service and the Mackenzie Forest Service. Suitable areas of natural beauty along the Dempster Route should be evaluated for national or territorial parks and the lands being tentatively reserved for park purposes.

Social Impact

The opening of the Dempster Highway will have a significant social impact on the residents of the Northern Yukon and Mackenzie Delta areas. The highway will allow people to travel within the region, it will facilitate travel to areas outside of the region, and it will bring in people from the outside. Also the Dempster Highway will serve to bring goods into northern communities throughout the year at a lower cost than presently available.

Northern residents served by the highway must be involved in the decision making process for the highway operation. The approximate population of communities on the Dempster Route are given in Table 11. The mechanisms of territorial government in the Yukon and Northwest Territories plus the local government councils in settlements along the route must participate. Observations need to be reviewed as to the social impact on local residents of the Alaska Highway and other roads leading into previously isolated communities. Consideration might be given to organize a Dempster Highway authority involving all of the interested parties.

Planning is required so that when the highway opens in 1975 northern people will be ready to participate in the activities and opportunities generated by the Dempster Highway. Otherwise well-meaning people from the South will move in and provide services while the local northern population without understanding or ability will be left standing by.

TABLE 11

Northern Population Along Dempster Highway

Dawson	750
Old Crow	150
Fort McPherson	850
Arctic Red River	100
Aklavik	700
Inuvik	3,500
Tuktoyaktuk	650
	6,700

TABLE 12

Possible Direct Employment Opportunities Along Dempster Highway

		No. jobs
1 - maintenance camps		
mechanic/foreman	1	
equipment operators	2	
trainee/labourer	2	
TOTAL	5 x 6 camps	30
2 - public service centers		
motel, restaurant, service station	5 x 6 centers	30
3 - truck driving		25
4 - bus operation		5
5 - construction - new roads & rebuilding		20
6 - Ferry operation and ice bridge construction		15
TOTAL JOBS		125

Northern people have to be involved in the benefits of the Dempster Highway. There can be no excuse for not providing northern people with whatever is required in the way of education, training, or financing so that they can effectively participate.

There will be possibly 125 job opportunities open up directly related to the Dempster Highway. A list of these opportunities is given in Table 12. At least another 125 "spin-off" job opportunities will open up as a result of the Dempster Highway such as employment in mining exploration, petroleum exploration, pipeline construction, and tourist camps.

The direct employment created by the Dempster Highway will be in the highway maintenance camps, public service centers, truck and bus driving, and road construction.

The maintenance camps could involve 5 men for equipment operations and maintenance. At each maintenance camp provision should be made for a public service center that would include a motel, restaurant and service station and would employ a staff of around 5 persons. For the general freighting and bus operation along the Dempster Highway an estimated 30 drivers and mechanics would be required. The construction of new roads and rebuilding original roads as well as bridges, guard rails, etc. would employ another 20 persons. The operation of ferries and the construction of ice bridges at Fort McPherson and Arctic Red River would employ another 15 people.

All of these positions can be filled by people now living in the Dempster Highway region, and, if required, training could be provided by the Yukon Vocational School in Whitehorse and the Adult Vocational School in Fort Smith under Canada Manpower sponsored programs. The elected councils in all the communities along the Dempster route must be given the opportunity of co-operating and providing local employment. These Dempster Route opportunities will be for owners, managers and workers in many trades and interests. Hopefully the employment opportunities will be structured to suit the temperament of the northern people. Consideration should be given to the operation of Public Service Centers along the highways as community cooperatives.

Environmental Factors

The construction and utilization of the Dempster Highway must relate to the northern environment. Other major northern construction projects such as the building of Canol Pipeline from Norman Wells to Whitehorse, the building of the Yukon highways north from Whitehorse to Mayo and Dawson, the construction

of the Alaska Highway indicate that the Dempster Highway can be built with tolerable disruption of the environment.

As in any part of the world, the construction of the Dempster Highway could have an adverse effect on the environment of the region. However, as the route is being effectively engineered by the Federal Department of Public Works which has considerable experience in northern road construction, as the route is now being constructed under a land use permit with environmental control from the Department of Indian Affairs and Northern Development, as the Canadian Wildlife Service has developed an environmental map series covering most of the region, and as industry and government groups are making a thorough environmental evaluation of the area for possible pipeline construction, it can be assumed that the Dempster Highway will have a minimum environmental impact on the region from an engineering viewpoint. To insure an understanding of the situation the Federal Department of Public Works is commissioning an environmental study specifically for the Dempster route.

The main environmental concern along the Dempster Route is not from engineering factors but from human factors. With the opening of the Dempster Highway, local residents and visitors will be able to readily travel into locations which previously had very difficult access. These people can be expected to provide new environmental problems with respect to forest and tundra fires, hunting and trapping, sanitation, and noise.

To minimize the human environmental factors regulations will have to be developed and enforced by the land use management, water management, game management, and land development offices. To assist in this environmental control the elected councils of the territories and communities must be involved.

Conclusion

The Dempster Highway when it is completed in 1974 will be a significant part of Canadian "northern development". This road to resources will do more than just connect the Arctic to Canada South as the prosperity of the Northern Yukon and the Mackenzie Delta areas will benefit through improved transportation. Indeed, the prosperity of all Canada will be enhanced by the mineral and petroleum developments of the region. This frontier highway will enable more Canadians to see and appreciate a significant part of their country.

Because of established competition by the Mackenzie truck-barge system and air carriers and because of the small populations in the North, the utilization of the Dempster Highway for regular

freight into northern communities will be relatively light but there will be a direct economic benefit for the northern residents. Most of the highway utilization will be in the support of mineral exploration, petroleum exploration, and pipeline construction. The Dempster route will facilitate freight originating in Vancouver to economically reach Inuvik. Previously most of the freight for the North Yukon and Mackenzie Delta areas originated in Edmonton.

The Dempster Route will benefit all residents of the region. To insure this a development plan is required that will provide the involvement of northerners in all phases of owner, manager, and employee opportunities. The benefits will not come immediately or easily. It is now up to northern residents, business, and government to make the optimum use of the opportunities available with the opening of the Dempster Highway.

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